1. INTRODUCTION

1.1. PROJECT OVERVIEW

The International Satellite Cloud Climatology Project (ISCCP), the first project of the World Climate Research Program (WCRP), was established in 1982 (WMO-35 1982, Schiffer and Rossow 1983):

(i) To produce a global, reduced resolution, calibrated and normalized radiance dataset containing basic information on the properties of the atmosphere from which cloud parameters can be derived.

(ii) To stimulate and coordinate basic research on techniques for inferring the physical properties of clouds from the condensed radiance dataset and to apply the resulting algorithms to derive and validate a global cloud climatology for improving the parameterization of clouds in climate models.

(iii) To promote research using ISCCP data that contributes to improved understanding of the Earth's radiation budget and hydrological cycle.

Since 1983 an international group of institutions (Section 4.1) has collected and analyzed satellite radiance measurements from up to five geostationary and two polar orbiting satellites to infer the global distribution of cloud properties and their diurnal, seasonal and interannual variations. The primary focus of the first phase of the project (1983 - 1995) was the elucidation of the role of clouds in the radiation budget (top of the atmosphere and surface). In the second phase of the project (1995 onwards) the analysis also concerns improving understanding of clouds in the global hydrological cycle.

The ISCCP analysis combines satellite-measured radiances (Stage B3 data, Schiffer and Rossow 1985, Rossow *et al.* 1987) with the TOVS atmospheric temperature-humidity (TV data, Section 6.1) and ice/snow (IS data, Section 6.2) correlative datasets to obtain information about clouds and the surface. The analysis method first determines the presence or absence of clouds in each individual image pixel and retrieves the radiometric properties of the cloud for each cloudy pixel and of the surface for each clear pixel. The pixel analysis is performed separately for each satellite radiance dataset and the results reported in the Stage DX data product (Sections 2.3 and 3.2), which has a nominal resolution of 30 km and 3 hr. The Stage D1 product is produced by summarizing the pixel-level results every 3 hours on an equal-area map grid with 280 km resolution and merging the results from separate satellites with the TV and IS datasets to produce global coverage at each time (Sections 2.2 and 3.1). The Stage D2 data product is produced by averaging the Stage D1 data over each month, first in each of eight 3-hour time intervals individually and then over all eight time intervals (Sections 2.1 and 3.1).

The first version of ISCCP cloud products, the C-series, covered the period from July 1983 through June 1991. On-going research indicated that a number of improvements and refinements of the analysis and reported statistics were possible. These changes have been implemented for processing of data in the period beyond June 1991; all older data will be re-processed into the newer version. This document describes the new cloud climatology data products produced by ISCCP (D-series), along with revised versions of the two correlative datasets (TOVS Atmospheric and Ice/Snow data).

1.2. SUMMARY OF CHANGES

Highlights of differences between the C-series and D-series cloud products are as follows.

Radiance Calibrations

- Revised VIS and IR calibrations to eliminate spurious changes between different reference polar orbiters (Brest *et al*. 1996)
- Revised normalizations of geostationary satellite calibrations to eliminate occasional short-term deviations (Brest *et al*. 1996)

Cloud Detection

- Improved cirrus detection over land by lowering IR threshold from 6 K to 4 K
- Improved polar cloud detection over ice and snow surfaces by lowering VIS threshold from 0.12 to 0.06 and by using threshold test on 3.7 μm radiances
- Improved detection of low clouds at high latitudes by changing to VIS reflectance threshold test

Radiative Model

- Improved treatment of cold (top temperature < 260 K) clouds by using ice polycrystal scattering phase function to retrieve optical thickness and top temperature
- Improved retrieval of cloud optical thicknesses over ice and snow surfaces using 3.7 μm radiances
- Improved retrieval of cloud top temperatures by including effects of IR scattering
- Improved retrieval of surface and cloud top temperatures by adopting new treatment of water vapor continuum absorption in IR

Gridded Product Contents

- Better resolved variations of optically thicker clouds by adding 6th optical thickness category
- Added correct cloud water path parameter
- Reported actual average values of cloud top temperature, pressure, optical thickness and water path for each of nine cloud types defined by cloud top pressure and optical thickness in the 3-hourly dataset
- Reported separate cloud properties for liquid and ice forms of low and middle-level clouds
- Provided conversion of cloud top pressures to cloud top heights above mean sea level based on atmospheric temperature profile
- Added cloud amount frequency distribution to monthly dataset

Increase Resolution

- Archived pixel-level cloud products with resolution of 30 km and 3 hr

1.3. DATA PRODUCTS

In the first phase of the project, only the gridded, 3-hourly (Stage C1) and monthly (Stage C2) datasets were made available (Rossow and Schiffer 1991, Rossow et al. 1991). These datasets cover the period from July 1983 through June 1991. In the second phase of the project, new versions of these two gridded products are being made available, called Stage D1 (3-hourly) and Stage D2 (monthly), as well as a "pixel-level" product (Stage DX). These products will cover the time period from July 1983 through June 1991 and beyond.

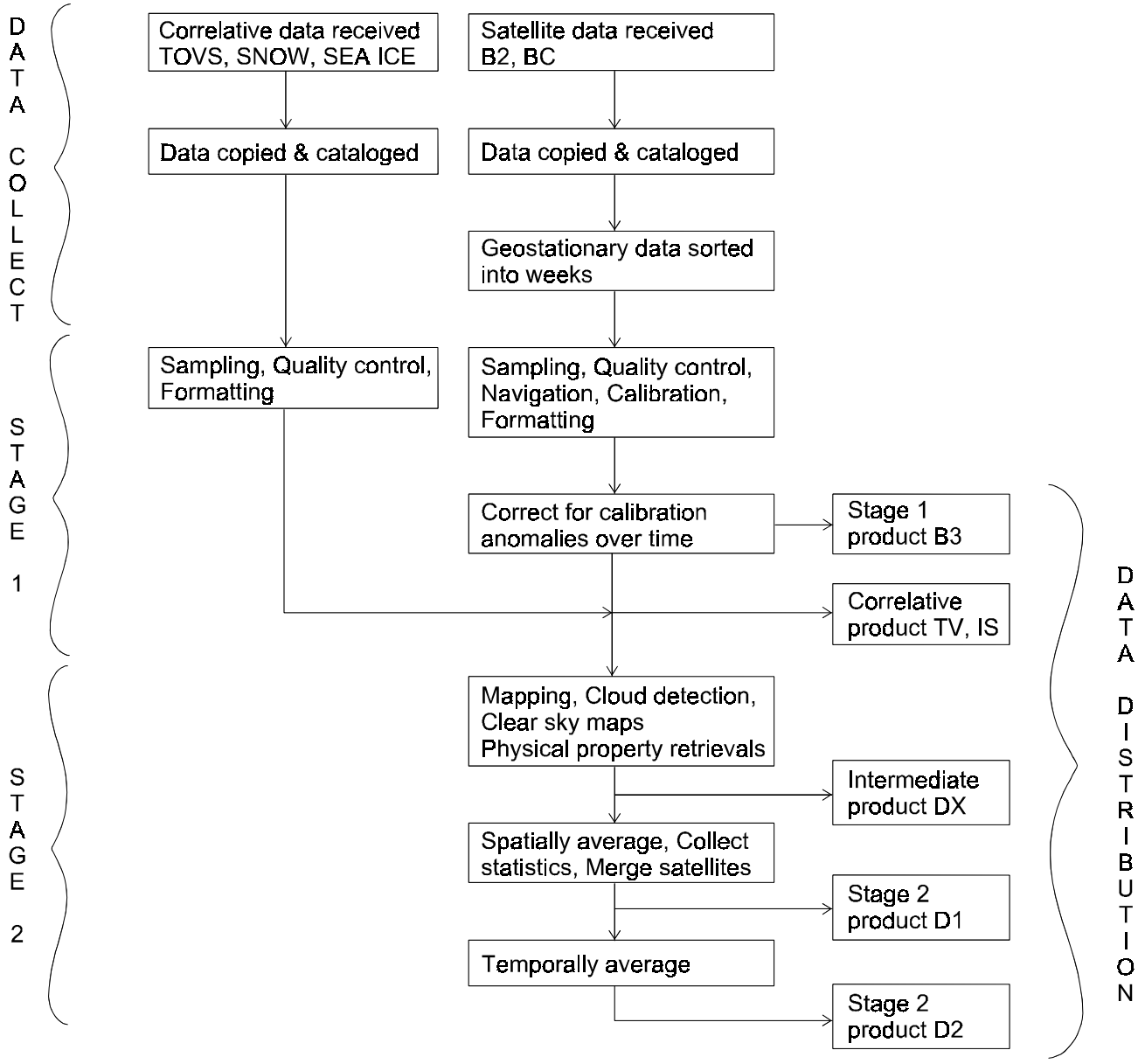

Figure 1.1. Schematic of ISCCP data processing and data products.

Reduced Resolution Radiance Data (B3)

Resolution: 4-7 km pixel at 30 km interval, 3 hr, individual satellites
Volume: 1.1 Gbyte per data month for global coverage
Contents: Radiances with calibration and navigation appended; uniform format for all satellites

Calibration Table Dataset (BT)

Resolution: 3 hr, individual satellites
Volume: 0.9 Gbyte per data year
Contents: Updated calibration tables for B3 dataset

Pixel-Level Cloud Product (CX -- not available publically)

Resolution: 30 km mapped pixels, 3 hr, individual satellites
Volume: 3.4 Gbyte per data month for global coverage
Contents: Calibrated radiances and viewing geometry, cloud detection results, cloud and surface properties from radiative analysis

Pixel-Level Cloud Product - Revised Analysis (DX)

Resolution: 30 km mapped pixels, 3 hr, individual satellites
Volume: 5 Gbyte per data month for global coverage
Contents: Calibrated radiances and viewing geometry, cloud detection results, cloud and surface properties from radiative analysis

Gridded Cloud Product (C1)

Resolution: 280 km equal-area grid, 3 hr, global
Volume: 216 Mbyte per data month
Contents: Spatial averages of CX quantities and statistical summaries; satellites are merged into global grid; atmosphere and surface properties from TOVS appended

Gridded Cloud Product - Revised Analysis (D1)

Resolution: 280 km equal-area grid, 3 hr, global
Volume: 320 Mbyte per data month
Contents: Spatial averages of DX quantities and statistical summaries, including properties of cloud types; satellites are merged into global grid; atmosphere and surface properties from TOVS appended

Climatological Summary Product (C2)

Resolution: 280 km equal-area grid, monthly, global
Volume: 4 Mbyte per data month
Contents: Monthly average C1 quantities including mean diurnal cycle; distribution and properties of total cloudiness and cloud types

Climatological Summary Product (D2)

Resolution: 280 km equal-area grid, monthly, global
Volume: 7.5 Mbyte per data month
Contents: Monthly average D1 quantities including mean diurnal cycle; distribution and properties of total cloudiness and cloud types

1.4. CONTACTS FOR ASSISTANCE AND DATA ORDERS

All of the ISCCP datasets are **produced** by the

ISCCP Global Processing Center
NASA Goddard Space Flight Center
Institute for Space Studies
2880 Broadway
New York, NY 10025
USA

For **technical** questions concerning data formats and software, contact

Alison W. Walker
Science Systems and Application Inc. at
NASA Goddard Institute for Space Studies
2880 Broadway
New York, NY 10025

Phone: 212-678-5542
FAX: 212-678-5552
e-mail: alison@giss.nasa.gov

For **scientific** questions about the cloud data products, contact

Dr. William B. Rossow
NASA Goddard Institute for Space Studies
2880 Broadway
New York, NY 10025

Phone: 212-678-5567
FAX: 212-678-5662
e-mail: clwbr@giss.nasa.gov

General **questions and comments** can be e-mailed to

isccp@giss.nasa.gov

The **ISCCP Home Page** provides more information about the ISCCP organization and data products, sample data and browse images, software, documentation and errata, radiance calibrations, current project status, and data availability. The World Wide Web URL is:

http://isccp.giss.nasa.gov

All ISCCP data products (except Stage DX data) are **available from**

ISCCP Central Archives
NOAA/NESDIS/NCDC
Climate Services Division/
Satellite Services Branch
FOB3, Room G233
Suitland, MD 20233

Phone: 704-271-4800 (option #5)
FAX: 704-271-4876
e-mail: satorder@ncdc.noaa.gov

All ISCCP data products (including Stage DX data) are also **available from** the EOS Distributed Active Archive Center at

User and Data Services
Langley DAAC
Mail Stop 157D
NASA Langley Research Center
Hampton, VA 23681-0001

Phone: 804-864-8656
FAX: 804-864-9807
e-mail: userserv@eosdis.larc.nasa.gov
telnet: eosdis.larc.nasa.gov
(logon ims, password larcims)